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Dundee Discussion Papers in Economics

'Make-or-Buy' in International Oligopoly and the Role of Competitive Pressure

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**‘MAKE-OR-BUY’ IN INTERNATIONAL OLIGOPOLY
AND
THE ROLE OF COMPETITIVE PRESSURE**

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Abstract: We study how competitive pressure influences the *make-or-buy* decision that oligopolistic firms face between producing an intermediate component in-house or purchasing it from a domestic supplier. We model outsourcing as a bilateral relationship in which the supplier undertakes relationship-specific investments. A home and foreign firm compete in the home market. Firms’ mode of operation decision depends on cost and strategic considerations. Competitive pressure increases firms’ incentive to outsource. Consumer gains from trade liberalisation are enhanced when it leads to less outsourcing.

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‘MAKE-OR-BUY’ IN INTERNATIONAL OLIGOPOLY AND THE ROLE OF COMPETITIVE PRESSURE

1. INTRODUCTION

This paper aims to shed light on the organisational form of production in oligopolistic settings. We focus on how changes in the level of competitive pressure influence the *make-or-buy* decision that a firm faces between producing an intermediate component in-house (thus opting for *vertical integration*) or purchasing it from a domestic supplier (i.e. *outsourcing* it to an upstream firm). We apply our analysis to a set up where trade liberalisation affects the mode of operation decision through its effects on the competitive pressure facing firms.

There has been a rapid expansion in outsourcing in recent years, with firms outsourcing activities as diverse as final assembly, R&D and after-sales services. The possibility of outsourcing faces the firm with fundamental decisions with respect to its mode of operation – whether to produce in house or to outsource and whether to outsource to domestic or to foreign suppliers. The growing importance of outsourcing has resulted in the huge increase in interest that this phenomenon has received, both empirically and theoretically, in the academic literature.¹

Although there is now a vast and diverse theoretical literature on outsourcing, the most influential strand of this dates back to Williamson (1975, 1985), and Grossman and Hart (1986) and is based on the role of incomplete contracts, asset specificity and transaction costs in guiding firms’ mode of operation decisions within choice theoretic frameworks that focus on the bilateral relationship between a single producer and a potential supplier. More recently, a number of authors have suggested the need to contextualise this relationship within theoretical frameworks that allow for the interdependence between firms’ choice and market structure and/or general equilibrium effects. McLaren (2000), Grossman and Helpman (2002, 2003, and 2005), and Antràs and Helpman (2004) endogenise market structure in frameworks with matching and find that outsourcing is more attractive the ‘thicker’ is the market for suppliers. Entry of upstream firms, in turn, is more likely the ‘thicker’ the market for potential buyers. In most cases in these models, downstream firms must choose between vertical integration that may involve higher governance costs and entering an outsourcing relationship with an upstream firm that is beset with problems of contract incompleteness which typically arise because the supplier must make a

¹ See for instance Abraham and Taylor (1996), Audet (1996), Feenstra (1998), Campa and Goldberg (1997), Hummels *et al* (2001), and Bartel *et al* (2005).

relationship specific investment (RSI) to customise the inputs for the downstream firms. Even though the final producer can recognise after delivery if the input has the desired features, firms cannot sign an enforceable contract ex-ante that specifies all its characteristics² – thus giving rise to a hold-up problem. Some of these papers focus on domestic outsourcing while others consider international outsourcing and foreign direct investment.³ In all cases, the theoretical models developed in this strand of the literature are based on general equilibrium frameworks with monopolistically competitive market structures and they thus abstract from strategic interaction between firms.

The majority of the theoretical literature on the mode of operation decision by firms hinges on the conventional view that outsourcing is mainly driven by cost considerations. In a sense, it could be argued that this also applies to the recent contributions by Antràs, Grossman and Helpman mentioned above, to the extent that ‘market thickness’ (by making matching more efficient) ultimately reduces costs. Cost considerations are of course important determinants of outsourcing.⁴ However, the existing empirical evidence is by no means conclusive as to the contribution of outsourcing to cost savings and/or to improvements in the quality of intermediates.⁵ This evidence suggests that cost-savings may not offer an exhaustive explanation of the widespread use of outsourcing.

We contend in this paper that in concentrated industries (where firms have significant degrees of market power) strategic considerations may interact with cost considerations in determining the make-or-buy decision of firms. Specifically, we argue that firms may choose their mode of operation strategically to affect the behaviour of competitors. Clearly, the exploration of this conjecture requires a departure from monopolistically competitive market structures to consider oligopolistic settings.

² As in Hart and Moore (1990), this contract incompleteness originates from the inability of third parties to verify the suitability of the inputs provided by the suppliers. See Spencer (2005) and Helpman (2006) for overviews.

³ In Grossman and Helpman (2002) firms choose between domestic outsourcing and vertical integration, in Grossman and Helpman (2003) firms choose between foreign direct investment and foreign outsourcing. Antràs and Helpman (2004) allow for all four possibilities – vertical integration at home or abroad and domestic and foreign outsourcing.

⁴ For instance, a recent UK survey by Manpower found that the main motivation behind outsourcing of services is cost reduction (<http://www.manpower.co.uk/news/OutsourcingSurvey.pdf>)

⁵ A recent survey by Software Development Magazine (2004) found that over half of the IT specialists interviewed reported that the quality of outsourced services was inferior to that produced in-house. For example, using firm-level panel data from the German cost structure survey over the period 1992-2000, Götzig and Stephan (2002) find that firms that outsourced service functions previously provided within the firm experienced a deterioration of return per employee. A negative relationship between outsourcing and firm level profitability is found for smaller firms by Görg and Hanley (2004) for the electronic industry in Ireland.

The existence of a link between strategy and firms' mode of operation is not entirely new. Within a Cournot setting, Nickerson and Vanden Bergh (1999) show that organisational choices are affected by strategic considerations in the firm-customer transactions. Shy and Stenbacka (2003) show that competition in the upstream industry affects production efficiency and the choice in the mode of operation of a downstream differentiated Bertrand duopoly when vertical integration involves higher fixed costs but lower marginal costs. Chen *et al* (2004) present a special case of outsourcing where an oligopolistic domestic firm may buy an intermediate from a more efficient firm that is also its competitor on the final goods market. This type of outsourcing, which facilitates collusion, differs substantially from the one we consider in this paper and highlights a different kind of strategic effect. To our knowledge, however, in the existing oligopoly literature on outsourcing issues related to incomplete contracts and relationship specific investment are not taken into account and their role in determining the nature of the trade-offs facing firms when making their mode of operation decisions are therefore disregarded.⁶

We develop an oligopoly model in which downstream firms that outsource⁷ enter a bilateral relationship with an upstream firm that must carry out a relationship specific investment. Rather than focusing on an incentive contract that tries to encourage investment – as in Grossman and Hart (1986) – we assume that if the final good firm chooses to outsource, then it and its intermediate input supplier bargain ex-post (after investment has been sunk) over the price of the intermediate. The fact that an enforceable contract cannot be written in advance of the relationship specific investment then gives rise to a hold-up problem that in this model leads to an underinvestment in quality which may in turn result in a higher marginal production cost. The literature on the organisation of production focuses on the effect of organisational costs on the choice of mode of operation.⁸ In our model the main advantage of vertical integration for the final producer is that it avoids the hold-up problem and its main disadvantage is the existence of a fixed corporate governance cost associated with managing a larger and more complex organisation.

⁶ Some contributions on the Japanese Keiretsu are more in line with the standard outsourcing literature. For instance, in Spencer and Qui (2001) downstream Cournot oligopolists buy from upstream keiretsu members in a context in which investment contracts cannot be written and upstream firms carry out relationship specific investments. Their paper, however, does not endogenise the outsourcing decision.

⁷ Following standard terminology, by outsourcing we mean the acquisition of an input or service from another firm. Bhagwati et al (2005) use the term in a much more restricted way to mean the acquisition of services from unaffiliated foreign firms.

⁸ The separation of organisational costs into managerial and transactions costs goes back to Coase (1937).

The basic model is introduced in Section 2 and the four-stage game between the home and foreign firm and the supplier of the intermediate is solved in Section 3. In Section 4, we examine the effects of trade liberalisation on the outcome of the game and on the welfare of consumers. Section 5 draws some conclusions and suggests some directions for future research.

2. THE MODEL

There are two final good firms, one located in the *home* country and one located in a *foreign* country. The firms produce a homogenous product and compete in the home market only.

Demand in the home market is given by:

$$p = a - (y + y^*), \quad (1)$$

where p is the price of the good, a is a constant parameter, and y and y^* are the quantities produced by the home and foreign firm respectively (henceforth, an asterisk will denote the foreign variables and parameters).

We assume that the production of the final good requires a specialised component, which is combined in fixed proportions with other inputs (such as labour). One unit of the customised intermediate is required per unit of output. We assume that both home and foreign firms can choose whether to become vertically integrated or to follow an outsourcing strategy, by purchasing the intermediate good from a domestic (i.e. located in their respective country) supplier.

Focusing on the home firm (the production setup for the firm is analogous), the intermediate input can either be produced in-house at a marginal cost of r or can be purchased from an upstream supplier at the price q . We model the other factors used in production as a composite input and normalise its price at unity. Let e be the number of units of this input required to produce a unit of output. Thus e is the contribution of the other inputs to the marginal cost. When a firm obtains an intermediate good, it must expend resources in order to adapt it to its particular needs. The greater the extent to which the intermediate has already been customised to fit the needs of the final producer, the easier it will be for the final producer to use it and the less resources the final producer will have to expend in adapting the input. Let $e = \bar{e} - k > 0$ be the per-unit input requirement for the composite input, where \bar{e} is a constant and k captures the ‘usefulness’ of the intermediate: a better intermediate is one that requires to be combined with fewer other inputs in order to produce a unit of output. Hence, the better the quality and

customisation of the intermediate good, the cheaper (or more efficient) are the other inputs used in production.⁹ The ‘usefulness’ of the intermediate to the final producer depends on the level of investment in its quality and customisation to the final good production. We will assume that $k = \sqrt{K}$, where K is investment in quality and customisation. Using the subscripts V and O to denote vertical integration and outsourcing respectively, marginal production cost for the domestic firm will thus be:

$$c_o = q + \bar{e} - k \quad (2a)$$

if the firm outsources its intermediate, and

$$c_v = r + \bar{e} - k. \quad (2b)$$

if it produces it in-house.

If the home firm is vertically integrated, its profit function is given by:

$$\pi_v = (p - c_v)y - k^2 - G, \quad (3a)$$

where $k^2 = K$ is the investment cost incurred with respect to the intermediate and G represents the fixed governance cost that a vertically integrated firm is assumed to incur. In line with the literature on vertical integration, we assume that governance costs are higher for a vertically integrated firm than for a firm that outsources; without loss of generality, we shall then set the governance cost for the latter to zero. If the firm chooses to outsource, its profit function will therefore be:

$$\pi_o = (p - c_o)y. \quad (3b)$$

Similarly, the profit functions for the foreign firm in the two regimes are respectively given by:

$$\pi_v^* = (p - c_v^* - t)y^* - k^{*2} - G^*, \quad (4a)$$

and

$$\pi_o^* = (p - c_o^* - t)y^*, \quad (4b)$$

where foreign marginal costs c_v^* and c_o^* in equations (4a) and (4b) are analogous to the corresponding home firm ones, and t is the transport cost incurred by the foreign firm in serving the home market.

Note that by outsourcing, a firm avoids both the governance cost as well as the investment cost on the intermediate. The latter, is now borne by the upstream supplier. In the home country,

⁹ For instance the better intermediate may allow the firm to economise on assembly costs. For a similar approach see Spencer and Qui (2001).

the supplier will earn revenue $(q - r_m)m$, where m is output of intermediates and r_m is the intermediate producer's marginal production cost.¹⁰ Since one unit of the intermediate is needed in the production of each unit of final output, we can write $m = y$. This firm must pay a fixed entry cost F , and has profit:

$$\mu = (q - r_m)y - k^2 - F. \quad (5)$$

Similarly, the profit of the intermediate firm in the foreign country will be given by:

$$\mu^* = (q^* - r_m^*)y^* - k^{*2} - F^*. \quad (6)$$

We now turn to the discussion of the game.

3. THE GAME

The model is a four stage game. In stage one, firms decide whether to outsource their intermediate or to produce it in-house. If they decide to outsource, they approach a specialised supplier firm, located in their respective domestic market, which will produce the intermediate.¹¹ In stage two, the firms invest in the development of the intermediate. If the downstream firms opt for outsourcing, then it is the specialised supplier firms that undertake this investment. In stage three, the firms (if they out-source) bargain with the intermediate supplier over the price of the intermediate. We assume that the final good producer only has enough time to negotiate with a single supplier. As in Grossman and Helpman (2003), should bargaining breakdown, the producer will not have sufficient time to produce the intermediate itself, and so will exit the market – while the supplier will have wasted its investment. In stage four, the intermediate is supplied and the final output is produced.¹²

In the final stage of the game the two firms engage in Cournot competition with outputs determined by the first-order conditions, respectively given by:

$$\pi_y = p - c - y = 0 \quad (7)$$

¹⁰ We assume that the marginal production cost of the intermediate can differ depending on whether it is produced in-house or by the upstream firm, thus r_m is not necessarily equal to r .

¹¹ One could think of there being ex-ante many identical potential intermediate suppliers. However, given that there is only one downstream firm, only one firm will enter in equilibrium since with more than one upstream firm, as a result of Bertrand competition between firms, the intermediate price would be driven to the marginal production cost and the firms will be unable to cover their investment and fixed entry costs – with more firms, the effective bargaining power of each intermediate producer would drop to zero (i.e., the downstream producer would induce mutual undercutting by the upstream firms to drive the price of the intermediate to marginal cost).

¹² This set up corresponds to the ‘*informal arrangement*’ described by McLaren (1999), who argues that trade liberalisation works towards less formality in contracting, making informal arrangements more likely.

and:

$$\pi_{y^*}^* = p - c^* - y^* - t = 0, \quad (8)$$

where c and c^* will vary depending on the mode of operation chosen by the firms. The resulting equilibrium output for the home and foreign firm respectively will then be:

$$y = \frac{a - 2c + c^* + t}{3}, \quad (9)$$

and:

$$y^* = \frac{a - 2(c^* + t) + c}{3}. \quad (10)$$

There are four regimes: (V,V), (V,O), (O,V), and (O,O), where the first letter refers to the home country and the second refers to the foreign country. Given the number of possible outcomes, and the corresponding binary choices of the firms, a detailed discussion of each individual regime would be very tedious and yield few additional insights. Instead, we shall look in detail at a situation in which, given the vertical integration of one of the firms, the other firm chooses its mode of operation. Once the nature of the strategic effects that are at play is understood, we shall then briefly discuss the other cases. Therefore, let us first consider the case in which the home firm vertically integrates and focus on the choice facing the foreign firm between vertical integration and outsourcing. We will then briefly discuss the outsourcing decision of the foreign firm when the home firm outsources as well as the outsourcing decisions of the home firm.

3.1. The home firm is vertically integrated

When the home firm is vertically integrated, we need to distinguish between the subgame in which the foreign firm also vertically integrates and the one in which it outsources. We shall discuss these two cases in the two next subsections respectively. Stage three of the game will only exist if the foreign firm chooses to outsource production of its intermediate input. In stage two, firms choose their level of investment in the intermediate good.

3.1.1. The foreign firm vertically integrates when the home firm is vertically integrated

We first consider the subgame in which the foreign firm produces the intermediate in-house. In choosing its optimal investment level, in stage two of the game each firm takes account of both

the direct cost-reducing effect of investment on its own profit and also the strategic effect on its rival's output in the final stage. Thus, the home firm's first-order condition is:

$$\frac{d\pi}{dk} = \pi_k + \pi_{y^*} \frac{dy^*}{dk} = 0, \quad (11)$$

where the first term on the right-hand side, $\pi_k = -c_k y - 2k = y - 2k$, is the direct effect of k on own profits. As regards the second term, $\pi_{y^*} = yp' = -y$, it can be shown from (10) that $dy^*/dk = c_k/3 = -1/3$. (Thus, the strategic effect $\pi_{y^*}(dy^*/dk)$ is positive and hence encourages the firm to invest more in the development of the intermediate good.) The first-order condition can then be rewritten as:

$$k = (2/3)y. \quad (12)$$

Similarly, the foreign firm's first-order condition for investment when it produces the intermediate in-house is:

$$\frac{d\pi^*}{dk^*} = \pi_{k^*}^* + \pi_{y^*}^* \frac{dy^*}{dk^*} = 0 \quad (13)$$

which implies:

$$k^* = (2/3)y^*. \quad (14)$$

3.1.2. *The foreign firm outsources when the home firm is vertically integrated*

We now consider the subgame in which the foreign firm outsources its intermediate. In stage three, it bargains with its supplier firm over the price of the intermediate.¹³ Recall that all fixed and investment costs are sunk at this stage. The price q^* of the intermediate good results from the maximisation of the following Nash bargain:

$$N^* = [(p - c_o^* - t)y^*]^{\beta^*} [(q^* - r_m^*)y^*]^{1-\beta^*}, \quad (15)$$

where β^* and $(1 - \beta^*)$ represent the bargaining power of the foreign downstream and upstream firms respectively. Taking the first-order condition of N^* with respect to q^* and rearranging, we obtain:

¹³ The purchase of intermediate components is sometimes assumed to involve the combination of a fixed lump-sum payment and a price set at marginal cost. As highlighted by Spencer (2005), however, the transfer of rents through lump-sum payments is at odds with stylised facts about domestic and international transactions. Our paper recognizes that outsourcing contracts typically involve strictly positive prices that exceed marginal costs.

$$q^* = r_m^* + \frac{3}{2} \left(\frac{1 - \beta^*}{1 + \beta^*} \right) y^*. \quad (16)$$

The equilibrium intermediate mark-up, $q^* - r_m^*$, falls in the foreign firm's bargaining power, but increases in its output y^* . The rent-extracting ability of the intermediate firm will be higher, *ceteris paribus*, the weaker is the bargaining position of the foreign final good producer and the larger is the latter's output. Although q^* must be larger than r_m^* , it needs not be higher than r^* . Note, however, that even if q^* is lower than r^* , it may still be the case that the marginal production cost of the vertically integrated firm is lower than that of a downstream firm that chooses to outsource: as we shall see, in fact, the level of investment may be lower under outsourcing.

Next, we will consider how the first-order conditions for investment are modified by the decision of the foreign firm to outsource. When the foreign firm chooses outsourcing, investment in k^* is undertaken by the intermediate firm.

We begin with the investment decision of the home firm. An increase in k will not now have as large a negative effect on the foreign firm's output as when the latter is vertically integrated. The reason for this is that an increase in k results in a lower q^* , thus helping to partially offset the negative impact on y^* . Thus, even though the home firm's first-order condition takes the same form as in (11), the derivative dy^*/dk is different, as k now also affects y^* through changes in q^* . Hence, the strategic incentive for home investment is lessened as a result of the endogenous change in the price of the intermediate because $dy^*/dk = (c_k/3) - (2/3)(dc_o^*/dk)$ with $dc_o^*/dk = dq^*/dk = (3/2)[(1 - \beta^*)/(1 + \beta^*)]dy^*/dk$. Rearranging, we get: $dy^*/dk = -(1/6)(1 + \beta^*) < 0$, the absolute value of which is less than that in the vertical integration case $(-1/3)$ except when $\beta^* = 1$, that is when the foreign firm has maximum bargaining power in its negotiations with the supplier firm. Thus, the first-order condition can be rewritten as:

$$k = \frac{(7 + \beta^*)}{12} y^*. \quad (17)$$

The distribution of rents between intermediate supplier and final good producer (and hence the return for relationship-specific investment) is determined through Nash bargaining over the price after investment is sunk.

A comparison of the investment-to-output ratios in (12) and (17) reveals that the home firm's equilibrium investment-to-output ratio is lower when its rival outsources its intermediate than when it produces it in-house (except when $\beta^* = 1$). Effectively, outsourcing by the foreign firm 'softens' the behaviour of its rival, inducing it to invest less per unit of output. As will become clearer later, this behaviour gives rise to a strategic motive for outsourcing.

In the foreign country, the supplier firm now undertakes the investment in the intermediate good. This firm chooses k^* to maximise (6). The intermediate firm only receives a share (determined by its bargaining power) of the rent generated by the investment; as a result, the firm does not fully appropriate the marginal benefit of its investment and this reduces the incentive to invest. In addition, note that the upstream foreign firm does not directly strategically interact with the home firm (this is evident from the profit function $\mu^*(y^*, k^*)$ which does not depend directly on y) – unlike the vertically integrated foreign firm which, as we saw earlier, does invest strategically. This also works to reduce the marginal benefit of investment.

We can use (16) in (6) to obtain:

$$\mu^* = \frac{3}{2} \frac{(1 - \beta^*)}{(1 + \beta^*)} y^{*2} - k^{*2} - F^*. \quad (18)$$

The first order condition for the profit maximising choice of k^* is then:

$$\frac{d\mu^*}{dk^*} = 3 \frac{(1 - \beta^*)}{(1 + \beta^*)} y^* \frac{dy^*}{dk^*} - 2k^* = 0. \quad (19)$$

It is straightforward to show that $dy^*/dk^* = (1 + \beta^*)/3 > 0$ and so the first-order condition can be written as:

$$k^* = \frac{(1 - \beta^*)}{2} y^*. \quad (20)$$

Note that as β^* rises, the producer invests less per unit of output as its share of the rents that are generated falls. In the limit, when the upstream firm has no bargaining power (i.e. $\beta^* = 1$), it will have no incentive to make any relationship-specific investment. This implies that the foreign equilibrium investment-to-output ratio is lower when a firm outsources its intermediate than when it produces it in-house.¹⁴

¹⁴ Another reason why the marginal benefit of investment for the intermediate firm tends to be lower than in an integrated firm is that output is below the rent maximising level, due to double marginalisation. Double marginalisation could be avoided by efficient bargaining or if the firms agreed on a two part tariff. This, however,

An important implication of this is that investment is very likely to be lower under outsourcing, unless there is a strong underlying cost advantage associated with it (i.e. unless $\rho^* = r^* - r_m^*$ is very large). Because of an underinvestment associated with outsourcing, it is easy to construct cases where outsourcing does not lead to lower marginal costs even when the price of the intermediate is lower than the marginal cost of producing it in-house (i.e. $q^* < r^*$). A lower level of investment under outsourcing translates into a low degree of customisation and quality which can offset the lower price of the outsourced intermediate good. As a result, a modest value of ρ^* (even one that gives rise to $q^* < r^*$) is not always enough to ensure that marginal costs are lower under outsourcing than under vertical integration. This result is of importance because it provides theoretical underpinnings for those empirical findings that suggest that outsourcing may be associated with a decrease in the quality of the intermediate.¹⁵

3.1.3. *The choice of the foreign firm's mode of operation*

To establish whether the foreign firm will outsource or choose to be vertically integrated we must compare its profits under the two regimes. However, since the ultimate aim of our analysis is to determine how the choice of the mode of operation can be used strategically by firms to affect the oligopoly game between them, it proves useful to first examine how the make-or-buy decision affects investment levels, equilibrium market shares and output levels. A natural approach to this question is to consider the effect of the mode of operation on the firms' output reaction functions. Nevertheless, these do not take account of the indirect effect of the foreign firm's outsourcing on output through changes in the level of investment and the price of the intermediate good. For instance, the foreign reaction function that is obtained from the output first-order condition in (8) can be written as $y^* = \psi^*(y; c^* + t)$, but the effect of outsourcing is on the c^* via changes in k^* and q^* . However, by making appropriate substitutions we can eliminate k^* and q^* (and k in the case of the home firm). Let us call the resulting functions *output response functions*¹⁶. In the absence of outsourcing, the output response functions for the home and foreign firms respectively, are:

would not overcome the fact that the share going to the investing firm is lower than unity due to its limited bargaining power. Hence, the main intuition of our model would qualitatively go through, but we feel it is more interesting and realistic to stick to our assumption.

¹⁵ See footnote 6.

¹⁶ These are effectively reduced form reaction functions.

$$y_{VV} = \frac{3}{4}[A - y_{VV}^*], \quad (21a)$$

where $A = (a - \bar{e} - r)$, and

$$y_{VV}^* = \frac{3}{4}[A - \Phi - y_{VV}], \quad (21b)$$

where $\Phi = (t + \bar{e}^* + r^*) - (\bar{e} + r)$ can be thought of as the underlying ('pre-investment') marginal cost disadvantage of the foreign firm; this disadvantage will be larger the higher the transport cost and the greater the difference between $(\bar{e}^* + r^*)$ and $(\bar{e} + r)$ which can reflect international relative factor price and productivity differences. An increase in Φ will then capture an increase in the relative competitive pressure faced by the foreign firm. When the foreign firm chooses to outsource, the corresponding output response functions are:

$$y_{VO} = \frac{12}{(17 - \beta^*)}[A - y_{VO}^*] \quad (22a)$$

and

$$y_{VO}^* = \frac{2(1 + \beta^*)}{(7 + \beta^*) - (1 - \beta^{*2})}[A - \Phi + \rho^* - y_{VO}], \quad (22b)$$

where ρ^* captures the difference between the marginal costs of producing the intermediate incurred by the downstream firm (when it is vertically integrated) and by the upstream intermediate producer.

These functions are illustrated in Figure 1. In the figure we assume ex ante symmetry between the firms, so that Φ is zero but we consider two cases: one where $\rho^* = 0$ and one where $\rho^* > 0$. The curves labelled R_h and R_f are the home and foreign output response functions when both firms are vertically integrated. The equilibrium is at point E . The curve labelled R_h' is the output response function of the home firm when the foreign firm outsources the intermediate; the curve labelled R_f' is the output response function of the foreign firm when it outsources and $\rho^* = 0$. In this case, the corresponding equilibrium is at point E' . Inspection of equations (21) and (22) reveals that, at $\rho^* = 0$, a switch to outsourcing by the foreign firm does not affect the zero-output intercept of these curves (which depend only on the terms in square brackets) and

merely results in a pivoting inward of the curves about the zero-output point.¹⁷ The home firm's output response function pivots inwards because its investment-output ratio is lower when its rival outsources. The reason the foreign output response pivots inwards is twofold. First, the firm now faces a higher marginal cost of the intermediate as the upstream firm captures some rents. Second, the investment to output ratio is now lower as explained earlier. At the new equilibrium E' total production is lower. If $\rho^* > 0$, then the foreign output response function, in addition to pivoting inward, also shifts outwards in a parallel manner. A comparison of (21) and (22) reveals that whilst a foreign firm switching to outsourcing does not affect the home firm's term in square bracket, it will affect that of the foreign firm if $\rho^* > 0$ – i.e. when the marginal cost of producing the intermediate is lower under outsourcing than under vertical integration. Note that outsourcing can raise foreign output at the expense of the home firm (as illustrated in Figure 1). For this to happen, however, ρ^* needs to be positive and very large, i.e. the upstream producer of the intermediate needs to have a significant marginal cost advantage over the foreign downstream firm.

Figure 1 about here

When $\Phi \neq 0$, the effect of outsourcing on firms' market shares will depend on the extent of the relative cost disadvantage between the two firms. For instance, at $\rho^* = 0$ and when the underlying competitive difference between firms is low, that is when Φ is small (as in Figure 1), outsourcing by the foreign firm lowers its market share and raises the market share of the home firm. This does not imply that outsourcing necessarily reduces foreign profits. It must be remembered that outsourcing also saves on governance costs and raises the market price. When Φ is large enough, i.e. when the foreign firm is sufficiently uncompetitive, the market share shifting effect of outsourcing is reversed. We show this in Figure 2 in which $\rho^* = 0$ and Φ is large. Compared to Figure 1, the foreign output response functions have moved inward. Inspection of (21) and (22) reveals that the home output response curves are independent of Φ , whilst an increase in Φ shifts the foreign firm's output response functions inwards in a parallel manner.

¹⁷ The home firm's output response function would remain unchanged in the limiting case of $\beta^* = 1$, when $q^* = r_m^*$ and $k^* = 0$.

In Figure 2, outsourcing by the foreign firm increases its own market share at the expenses of the home firm. With $\rho^* = 0$, the change in regime between outsourcing and vertical integration causes the output response curves to pivot around the firms' zero output points. Thus, the effect of outsourcing on an output response curve is greater the further we are away from the firm's zero output point. When Φ is high, the foreign firm's relative market share is small and the negative impact of outsourcing on the foreign output response curve is locally very small, while the negative effect on the corresponding home curve is locally much larger. The net result is that home output falls and foreign output rises. Note that the seemingly paradoxical result that $y_{VO}^* > y_{VV}^*$, when Φ is very large despite an inward shift of the output response curve, is due to strategic interaction between firms under oligopoly and would not occur under monopoly. The firm's decision to outsource can raise its own market share when the effect on the strategic aggressiveness of its rival is very strong. This is more likely to be the case the larger the rival's market share in the initial equilibrium, because the bigger and more powerful is one's competitor, the larger the gain from reducing its aggressiveness.¹⁸ Because of this strategic effect, outsourcing can sometime be optimal even when it is unambiguously cost increasing.¹⁹

Figure 2 about here

The above analysis can be summarised by the following proposition:

Proposition 1: (i) Outsourcing by the foreign firm can never result in an increase in the output of both firms; (ii) At $\Phi = \rho^* = 0$, the foreign firm's output always falls if it outsources; (iii) at $\Phi = 0$, there always exists a ρ^* large enough that, following outsourcing, the foreign firm's output rises at the expense of the home firm's one; (iv) at $\rho^* = 0$, there exists a Φ large enough such that outsourcing increases the foreign firm's output at the expense of the home firm's.

Proof: see Appendix A.

Equipped with this analysis, we can now proceed to compare the profits of the foreign firm under outsourcing and under vertical integration (given home vertical integration). To this end, it is useful to obtain an expression for profits in terms of outputs and parameters only.

¹⁸ In this analysis we have, for simplicity, focused on the case of $\Phi > 0$. If $\Phi < 0$, the home firm is small and the returns to the foreign firm from reducing its aggressiveness by outsourcing is consequently reduced. Hence, at $\rho^* = 0$ and $\Phi < 0$, outsourcing could never increase the foreign firm's output. Therefore, $\Phi < 0$ is qualitatively a special case of Φ small.

¹⁹ In the case shown in Figure 2, even when $G^* = \rho^* = 0$, outsourcing increases the profit of the foreign firm.

The output first order condition in (8) and the profit function under outsourcing in (4b) yield:

$$\pi_{VO}^* = (y_{VO}^*)^2. \quad (23)$$

The corresponding expression under vertical integration is obtained by using the first-order conditions for output and for investment, given by (8) and (14) respectively, in (4a) to get

$$\pi_{VV}^* = \frac{5}{9}(y_{VV}^*)^2 - G^*. \quad (24)$$

It is immediately obvious from equations (23) and (24), that a sufficient condition for outsourcing to yield higher profits is $y_{VO}^* \geq y_{VV}^*$.

The key parameters that affect the profit comparison are β^* , G^* , ρ^* and Φ . An increase in ρ^* , by making the outsourcing technology more efficient, clearly works against vertical integration. The effect of β^* on the outsourcing profits is small and ambiguous.²⁰ The effect of a higher G^* is clearly to reduce π_{VV}^* and so make outsourcing more attractive. Finally, turning to the effect of the relative cost competitiveness Φ on the relative attractiveness of outsourcing, it is clear that an increase in Φ will reduce both π_{VO}^* and π_{VV}^* . However, its effect on π_{VV}^* is greater than its effect on π_{VO}^* .²¹ This is because, when the foreign firm outsources, the negative effect of a higher Φ is partially offset by a fall in q^* .

A comparison of the profits of the foreign firm under the two regimes enables us to determine whether a threshold level of Φ exists that will induce a switch in the firm's preferred mode of operation.

Figure 3 plots the foreign firm's *indifference profit locus*, in Φ and G^* space at $\rho^* = 0$, i.e. the figure shows the combinations of (Φ and G^*) at which $\pi_{VO}^* = \pi_{VV}^*$ (for given values of β^* and the other parameters).²² For any given level of Φ , the indifference profit locus gives the critical

²⁰ On the one hand, a higher β^* raises the profit share of the downstream firm directly. On the other hand, it further increases the upstream firm's underinvestment in the quality and the customisation of the intermediate input. This second effect works to lower downstream profits.

²¹ This situation will be reversed for sufficiently large values of ρ^* and/or Φ , i.e. well above the level at which there is a trade-off between outsourcing and vertical integration. This region is not very interesting, however, because outsourcing is then trivially dominant.

²² The figure is drawn for $\beta^* = 1/2$. However, it can be shown that even large changes in β^* make no qualitative difference.

level of governance costs above which the foreign firm will chose to outsource. In the region above (below) the curve, for any given level of Φ , governance costs are high (low) and the foreign firms chooses outsourcing (vertical integration).²³

Figure 3 about here

As is clear from the figure, the critical value of G^* falls in Φ indicating that from the final goods producer's perspective an increase in competitive pressure works in favour of outsourcing. The explanation for the negative slope of this locus is that the profits under outsourcing fall less quickly in Φ than the profit under vertical integration. The reason for this is twofold. Firstly, an increase in Φ strengthens the foreign firm's strategic incentive to outsource in order to reduce the aggressiveness of the home firm. Secondly, an increase in Φ also reduces the strategic incentives to vertically integrate. To see this, consider that when the firm chooses vertical integration, it trades off a higher fixed cost for higher operating profits.²⁴ The relative gain from vertical integration depends on this improvement in operating profits achieved in exchange for the higher fixed governance costs. However, the difference in operating profits between the two modes of operation narrows in Φ , as under outsourcing the fall in q^* works to cushion the fall in operating profits – while no such effect occurs under vertical integration.

At approximately $\Phi/A=0.22$, the indifference locus falls below zero: hence, outsourcing is always preferred when, due to high competitive pressure, the firm's market share is small. This is not surprising given that, as we saw above, a sufficient condition for $\pi_{VO}^* > \pi_{VV}^*$ is that $y_{VO}^* \geq y_{VV}^*$ (it has been stated in Proposition 1.(iv) and shown in Figure 2 that a large enough value of Φ exists such that the latter inequality holds). When the locus falls below the axis, the firm will choose to outsource even when $G^*=0$ (and $\rho^*=0$). In this region, $q^* > r_m^* = r^*$. Thus, outsourcing is optimal in this region even though it is unambiguously cost increasing. This region corresponds to the case shown in Figure 2, in which the pure strategic motive for outsourcing dominates. The result that outsourcing is more likely when the firm faces a high competitive pressure is consistent with empirical evidence that points to the fact that the use of subcontractors is more common amongst smaller and less profitable firms – e.g. Kimura (2002).

²³ Of course, at some parameters values there is no trade-off between outsourcing and vertical integration but, by its very nature, there must be such a trade-off on an indifference locus.

²⁴ Note that along the locus, because there is a fixed governance cost of vertical integration, the marginal cost under vertical integration must be lower than under outsourcing for the profits to be equal in the two regimes.

It is interesting at this stage to point out that, since outsourcing is a bilateral relationship, even if the final good producer wishes to outsource, an outsourcing firm may not find a firm willing to supply it with the intermediate input. In fact, moving to consider the ‘supply’ of outsourcing, an increase in Φ reduces *ceteris paribus* the profits of the supplier firm μ^* . To see this, use the first-order condition for investment under outsourcing in (20) to substitute out k^* in (18) to yield:

$$\mu^* = (y^*)^2 \frac{(1-\beta^*)}{2} \left[\frac{6-(1-\beta^{*2})}{2(1+\beta^*)} \right] - F^*. \quad (25)$$

From (25), we can see that μ^* is increasing in y^* and thus is falling in Φ – i.e., an increase in competitive pressure may prevent the provision of an outsourcing service since, given $F^* > 0$, there is a threshold level of Φ above which outsourcing is impossible as the supplier will not find it profitable to enter. Thus, at a high level of Φ the foreign firm would be *forced back* to vertical integration – and this level of Φ is lower the higher is F^* .

These results suggest that it is in the intermediate range level of competitive pressure that outsourcing is most likely.

3.2. Both Firms Choose the Mode of Operation

Having examined in detail the foreign firm’s choice of mode of operation, when the home firm is vertically integrated, we will now briefly consider the remaining cases.

The home firm’s choice between outsourcing and vertical integration when its rival is vertically integrated is essentially the same as that of the foreign firm discussed above. With the foreign firm vertically integrated, the home firm’s indifference locus is the curve $\pi_{VV} = \pi_{OV}$. However, note that an increase in Φ improves the competitive position of the home firm and thus works to improve its relative return to vertical integration. Hence, this curve slopes upwards in (Φ, G) space (see Figure 4). As discussed above for the case of the foreign firm, the choice of vertical integration involves trading off high fixed costs for low marginal costs. As the home firm’s relative cost competitiveness rises, the relative disadvantage of incurring the governance cost falls and hence the relative return from expanding production via the vertical integration option rises. Indeed, the choice of vertical integration is strategically more aggressive, because it involves lower marginal costs and hence higher output in exchange for higher governance costs.

A fall in Φ , by increasing the competitive pressure on the home firm, would increase the relative attractiveness of outsourcing even though by outsourcing the firm further reduces its output.

Figure 4 about here

The figure also shows the $\pi_{VO} = \pi_{OO}$ and $\pi_{OV}^* = \pi_{OO}^*$ loci. Once again, an increase in the firms' competitiveness raises the relative return from vertical integration. Thus, as with the other loci, the home (foreign) locus slopes up (down) in Φ . As for the intercepts of these curves, it can be seen that at $\Phi=0$ (i.e. when the firms are *ex-ante* symmetric), the relative incentive to vertically integrate is higher when the rival firm chooses to outsource. The explanation for this is essentially the same as the explanation for the fact that an increase in relative competitiveness raises the relative incentive to vertically integrate. *Ceteris paribus* a firm's incentive to be vertically integrated tends to be higher when its rival outsources, because outsourcing by a rival softens the competitive pressure a firm faces. However, when the foreign firm vertically integrates, the competitive advantage of the home firm as Φ increases rises more quickly than when its rival outsources. This translates into a steeper indifference locus for the home firm when the foreign firm vertically integrates. In other words, with foreign outsourcing, the home firm's incentive to vertically integrate is rising faster in Φ , because the increase in Φ is partly offset by a fall in q^* . This explains why, in the diagram, the intercept of the $\pi_{VO} = \pi_{OO}$ and $\pi_{OV}^* = \pi_{OO}^*$ loci are above those of the $\pi_{VV} = \pi_{OV}$ and $\pi_{VV}^* = \pi_{VO}^*$ loci and yet the two home loci cross at higher values of Φ .

These four loci can be used to demarcate the equilibrium regime areas. Above all the loci in Figure 4, outsourcing is the dominant strategy for both firms, so (O,O) is the unique equilibrium. Although not in a region in which both firms have a dominant strategy, (O,O) is also the unique equilibrium in the area trapped between the two home firm's loci and to the right of their intersection. This is because this area lies above both of the foreign firm's loci, where the foreign firm's dominant strategy is outsourcing; hence, the only relevant locus for the home firm is $\pi_{VO} = \pi_{OO}$. Since this region lies above that locus, outsourcing is the best response for the home firm to foreign outsourcing and hence (O,O) must be the unique equilibrium. Outsourcing by both firms occurs only in the area above this locus. Below all the loci, vertical integration is the dominant strategy for both firms, hence (V,V) is the unique equilibrium in that region. (V,O) is an equilibrium everywhere in the region enclosed by the $\pi_{VO} = \pi_{OO}$ and $\pi_{VV}^* = \pi_{VO}^*$ loci. In

this region, the optimal strategy for the home firm is to vertically integrate, given that the foreign firm outsources, and the best reply for the latter is to outsource, given that the home firm vertically integrates. In the area bordered by the loci $\pi_{OV}^* = \pi_{OO}^*$ and $\pi_{VV} = \pi_{OV}$, (O,V) is also an equilibrium – together with (V,O). In this region, outsourcing is the best response for the home firm to foreign vertical integration, and vertical integration is the best response for the foreign firm to home outsourcing – at the same time, home vertical integration is the best response to foreign outsourcing and foreign outsourcing is the best response to home vertical integration. Hence, this is a region of multiple equilibria. These equilibrium regimes are represented in Figure 5.

Figure 5 about here

Hence, as can be seen from the figure, asymmetric equilibria are possible in this model, unlike the monopolistically competitive models such as those of Grossman, Helpman and Antràs. This is an important result, because it is consistent with the stylised fact that firms within the same industry often adopt different mode of operation strategies. Asymmetric equilibria are more likely the more asymmetric the underlying marginal cost structures of the firms (i.e. the larger is Φ in absolute value). This can be seen in the figure, where (V,O) becomes more likely the larger is Φ (and the foreign firm has a strong competitive disadvantage). However even when $\Phi=0$, that is with full ex-ante symmetry between firms, there is an intermediate range of G where asymmetric equilibria occur.

Differences in Φ can be driven by two things: differences in transport costs or differences in underlying marginal costs (which may in turn be due to international differences in factor prices, in particular labour costs). If there are underlying differences in factor costs, then these may also give rise to differences in the level of the fixed governance cost. Hence, if foreign factor prices are higher, we may then expect $G^* > G$. Let $G^* = \gamma G$ with $\gamma > 1$. Then, it is easy to show that in the (Φ, G) space, an increase in γ shifts the foreign loci downward proportionally – hence resulting in less foreign and more home vertical integration.

4. TRADE LIBERALISATION

In this section we briefly bring out the implications of our analysis for the effects of trade liberalisation, modelled as a fall in the level of trade costs t , on firms' optimal mode of operation. We shall also briefly explore its implications for the consumer.

As we saw in the previous section, a fall in trade costs will change the level of Φ . This will have implications for output, prices and investment under a give regime, but under some circumstances it will also lead to a regime shift. We shall begin by examining the effects of trade liberalisation within a given regime and then consider its effects on regime outcomes.

Under a given regime, a fall in t improves the relative competitive position of the foreign firm at the expense of the home firm and this will result in a market share reallocation in favour of the former. Under outsourcing, this market share reallocation results in an increase in the negotiated price of the intermediate in the foreign country, provided that the supplier firm has some bargaining power. Trade liberalisation will have the opposite effect in the home country, where it will lead to a fall in the negotiated price of the intermediate good. This is because trade liberalisation increases (decreases) the available rents in the foreign (home) country. As a result of trade liberalisation, the decline in the output of the home firm is proportionally smaller, due to the asymmetric effects of trade costs on the firms. Hence, the final good's price must fall, as t falls. These results are summarised in the following proposition:

Proposition 2: For a given regime, trade liberalisation leads to (i) under both outsourcing or in-house production, an increase (fall) in foreign (home) output and investment, and a fall in the market price; (ii) under outsourcing, an increase (decrease) in the price of the intermediate good in the foreign (home) country.

Proof: see Appendix B.

Trade liberalisation can also lead to regime shifts as it can affect firms' decision about their mode of operation. As we saw in the previous section, a fall in t (i.e. in Φ) will increase the incentive of the foreign firm and decrease the incentive of the home firm to choose vertical integration.²⁵

In Figure 6, which is similar to Figure 5 but has trade costs on the horizontal axis and $G=G^*$ on the vertical axis, at free-trade the foreign firm has an underlying cost advantage. In notational terms, $\Phi < 0$ at $t=0$.²⁶

Figure 6 about here

²⁵ Under outsourcing, trade liberalisation increases the profit of the intermediate supplier in the foreign country and reduces the profit of the intermediate supplier in the home country. Clearly, excessive competitive pressure can prevent outsourcing from being supplied, as discussed at the end of Section 3.1.3.

²⁶ Giving the foreign firm a cost advantage at free-trade allows us to present cases in which Φ is positive and cases in which it is negative on the same diagram. At high values of t ($\Phi > 0$) the home firm has a cost advantage, while

As can be seen from Figure 6, at sufficiently low levels of governance costs, and $\Phi > 0$, a fall in t will eventually lead to switch from the (V,O) to the (V,V) regime (as the home firm stays vertically integrated and the foreign firm is induced to change regime). At negative values of Φ , further trade liberalisation can result in a switch from (V,V) to (O,V). At sufficiently high levels of governance costs, and $\Phi > 0$, trade liberalisation leads to a move from (V,O) to (O,O), as the home firm is induced to outsource, whilst the foreign firm remains outsourced. When $\Phi < 0$, further trade liberalisation can result in a shift to the (O,V) equilibrium region.

Proposition 3: At a given $G > 0$: (i) Trade liberalisation can never lead to a switch towards (away from) vertical integration for the home (foreign) firm; (ii) In the neighbourhood of a switch by one of the firms to vertical integration (outsourcing), there will a discrete increase (fall) in that firm's output and in industry output, and a fall (increase) in the output of the rival firm.

Proof: see Appendix C.

As discussed previously, asymmetric equilibria are more likely the more asymmetric the underlying marginal cost structures of the firms (i.e. the larger is Φ in absolute value). Thus, in the Figure 6, we see that (V,O) is the typical outcome when t is high and hence the foreign firm has a strong competitive disadvantage, but for low trade costs, (O,V) can emerge as the competitive advantage swings towards the foreign firm. Also note that the range of G over which multiple equilibria occurs is at its largest when Φ is zero.

Finally, we can now briefly explore the implications of the analysis for the effects of trade liberalisation on the consumer in the home country. Trade liberalisation at a given regime raises output (see Proposition 2) and thus works to increase consumer surplus. This increase in consumer surplus is further enhanced when a threshold is crossed that leads the foreign firm to switch to vertical integration. This is because when the foreign firm switches to vertical integration, both its own and the industry outputs experience a discrete upward jump. Trade liberalisation however leads to a discrete downward jump in consumer surplus when it results in the crossing of a threshold that brings about a switch to outsourcing by the home firm. This implies that, somewhat counter-intuitively, consumer surplus is not always maximised at free-trade.

at low values of t ($\Phi < 0$) the foreign firm has a cost advantage. Other constellations of parameters values can be considered but this one is chosen because it captures all the interesting cases.

5. SUMMARY OF THE RESULTS AND CONCLUSIONS

In this paper we have developed a model of endogenous outsourcing in an international oligopoly setting. In line with some other recent theoretical contributions, we have modelled the outsourcing arrangement as one where a final good producer enters a bilateral relationship with an upstream supplier which undertakes a relationship-specific investment. Earlier work that has adopted this approach has done so within a non-strategic monopolistically competitive market structure. We have demonstrated that the oligopolistic setup implies that additional strategic considerations may play a role in explaining the choice of mode of operation of firms. In particular, we have shown that both strategic vertical integration and strategic outsourcing are possibilities in our model.

A vertically integrated firm incurs additional governance costs that can be avoided by sourcing components outside the firm. If the outside supplier is not significantly more efficient at providing the intermediate to the required specifications, however, outsourcing will raise the final goods producer's marginal production costs since the supplier fails to fully internalise the marginal benefit of investment. Outsourcing then involves accepting higher marginal costs in exchange for a saving on fixed (governance) costs. In a Cournot oligopoly setting, this gives rise to an additional strategic incentive to vertically integrate – as the lower marginal costs reduce the rival's output and thus indirectly raises the integrated firm's profits.²⁷ However, strategic outsourcing is also a possibility even when it results in higher marginal costs. This is because when a firm chooses outsourcing, the rival firm's incentive to invest strategically is reduced. We have shown that when a firm has a sufficiently small market share under vertical integration, it has an incentive to strategically switch to outsourcing so as to increase its own and reduce its rival's investment and output.

Unlike most contributions in the outsourcing literature (e.g. Grossman and Helpman, 2002), this model gives rise to the possibility of 'mixed outcomes' in which, even when firms are ex-ante symmetric, they may choose different modes of operation in equilibrium; this is consistent with existing stylised facts whereby not all firms in the same industry and in all countries adopt the same mode of operation strategy.

²⁷ Of course, if the outside supplier is much more efficient at providing the intermediate to the required specifications than the final goods producer, then outsourcing could lower both marginal and fixed costs. There would then be no trade-off between vertical integration and outsourcing as cost considerations would leave outsourcing as the dominant strategy.

In our model, the choice of the mode of operation by firms is shown to depend on the combined effect of strategic considerations and the competitive pressure facing firms. In general, we find that an increase in competitive pressure leads to a greater ‘demand’ for outsourcing. When a firm faces an exogenous increase in its marginal production costs or a fall in that of its rival, its share in total investment is lower and it has more to gain from inducing its rival to be less strategically aggressive in its choice of investment. Thus, competitive pressure strengthens the strategic incentive for outsourcing. In addition to this effect, firms under intense competitive pressure are relatively less able to gain from taking on the fixed vertical integration costs in exchange for lower marginal production costs as these lower costs apply to a relatively smaller market share. Thus, competitive pressure weakens the strategic incentive to vertically integrate. Taken together, these two effects imply that an increase in competitive pressure will work in favour of outsourcing. Although the ‘demand’ for outsourcing tends to increase in the extent of competitive pressure, the ‘supply’ of outsourcing will decrease; this is because the profitability of the intermediate goods producer decreases when the upstream firm requires fewer inputs and rents fall. Thus our model suggests that we can expect outsourcing to be more likely when firms face intermediate levels of competitive pressure.

Trade liberalisation directly impacts on the competitive pressure facing the firms – intensifying it for the home final goods firm and relaxing it for its foreign rival. Thus, a fall in trade costs makes outsourcing more likely in the home country and it reduces the relative returns to outsourcing for the foreign firm. This is because firms with a lower marginal cost are better able to reap the benefits of freer trade.

We also considered the implications of trade liberalisation and endogenous outsourcing for consumers. Since the higher marginal costs that outsourcing implies leads to higher final goods prices, the benefits of trade liberalisation for consumers are enhanced when it leads to less outsourcing.

The model developed in this paper allows for the endogenous emergence of different mode of operation equilibria and yields results that are not always obvious but contribute to explain stylised facts. Whilst fairly simple, the basic framework developed in this paper is flexible enough to allow to be easily extended to consider different outsourcing scenarios (such as sourcing from abroad rather than domestically) and alternative assumptions concerning the trading setup. Preliminary results on these extensions allow us to strongly conjecture that the main effects of competitive pressure on the outsourcing decision of firms are robust.

Appendix A – Proof of Proposition 1

We will find it useful to rewrite the output response functions in compact form:

$$y_{ij} = \frac{A + \delta \rho - y_{ij}^*}{b_{ij}} \text{ and } y_{ij}^* = \frac{A + \delta^* \rho^* - \Phi - y_{ij}}{b_{ij}^*} \quad (\text{A1})$$

where $i=O,V$ is the mode of operation of the home firm and $j=O,V$ is the mode of operation of the foreign firm. The parameter $\delta (\delta^*)$ is an indicator variable that is unity if the home (foreign) firm outsources and zero if it is vertically integrated.

In this proposition we are concerned with the (V,O) and (V,V) equilibria. Thus, importantly:

$b_{VV} = b_{VV}^* = 4/3$, $b_{VO} = (17 - \beta^*)/12$ and $b_{VO}^* = \{(7 + \beta^*) - (1 - \beta^{*2})\}/\{2(1 + \beta^*)\}$. A ranking of the b_{ij} s and b_{ij}^* s will prove useful and it is easy to verify that $b_{VO}^* > b_{VO} \geq b_{VV}$. The final inequality will be strict when: $\beta^* < 1$.

Proof of Proposition 1(i). The home firm is vertically integrated. Its output when the foreign

firm is also vertically integrated is $y_{VV} = \frac{A - y_{VV}^*}{b_{VV}}$. A comparison of this with its output when the

foreign firm chooses outsourcing, $y_{VO} = \frac{A - y_{VO}^*}{b_{VO}}$, gives: $b_{VO} y_{VO} - b_{VV} y_{VV} = y_{VV}^* - y_{VO}^*$. Now,

since $b_{VO} \geq b_{VV}$, we have that if $y_{VO} \geq y_{VV}$ then $y_{VV}^* \geq y_{VO}^*$, and if $y_{VO}^* \geq y_{VV}^*$ then $y_{VV} \geq y_{VO}$.

Thus the firms' outputs cannot both increase when the foreign firm outsources.

Proof of Proposition 1(ii). Solving the (V,V) subgame, we obtain the reduced form expression

for foreign output when $\Phi = 0$: $y_{VV}^* = \frac{A}{b_{VV} + 1}$ (note that $b_{VV}^* = b_{VV}$). The corresponding

expression when the foreign firm chooses to outsource (assuming that $\Phi = \rho^* = 0$) is

$y_{VO}^* = \frac{A(b_{VO} - 1)}{b_{VO}^* b_{VO} - 1}$. This must be smaller than $\frac{A}{b_{VO} + 1}$ which in turn is at least as small as

$y_{VV}^* = \frac{A}{b_{VV} + 1}$. Hence, at $\Phi = \rho^* = 0$ foreign output falls when the foreign firm outsources.

Proof of Proposition 1(iii). The larger is ρ^* , the more the foreign output response curve shifts outwards. It is obvious that if this shift is large enough then the foreign output rises. From part (i) of the proposition, this will lead to a fall in home output.

Proof of Proposition 1(iv). Solving the (V,V) subgame, we obtain the reduced form expression for foreign output: $y_{VV}^* = \frac{A(b_{VV} - 1) - b_{VV}\Phi}{(b_{VV})^2 - 1}$. This falls in Φ and reaches zero at $\Phi = \tilde{\Phi}_{VV}$, where

$$\tilde{\Phi}_{VV} = \frac{(b_{VV} - 1)}{b_{VV}} A. \text{ When this value of } \Phi \text{ is substituted into } y_{VO}^* = \frac{A(b_{VO} - 1) - b_{VO}\Phi}{b_{VO}^* b_{VO} - 1}, \text{ it is clear}$$

that this equation is still positive if $b_{VO} > b_{VV}$ (which is guaranteed when $\beta^* < 1$). This means that there are values of Φ at which outsourcing raises foreign output (provided that $\beta^* < 1$). From part (i) of the proposition, this also implies that there are levels of Φ at which the home output must definitely fall when the foreign firm chooses to outsource.

Appendix B – Proof of Proposition 2

We will use the same notation as in Appendix A.

Totally differentiating the equations in (A1) we get:

$$dy_{ij} = \frac{-dy_{ij}^*}{b_{ij}} \text{ and } dy_{ij}^* = -\frac{(dt + dy_{ij})}{b_{ij}^*} \text{ where we hold constant } A, \rho, \rho^* \text{ and the components of}$$

Φ other than t . Solving for the effect of trade costs on outputs, we get:

$$\frac{dy_{ij}}{dt} = \frac{1}{b_{ij}b_{ij}^* - 1} > 0, \quad \frac{dy_{ij}^*}{dt} = \frac{-b_{ij}}{b_{ij}b_{ij}^* - 1} < 0 \text{ and } \frac{dp_{ij}}{dt} = \frac{b_{ij} - 1}{b_{ij}b_{ij}^* - 1} > 0. \text{ From the first-order conditions}$$

for k we obtain expressions that take the form: $k_{ij} = \kappa_{ij} y_{ij}$ and $k_{ij}^* = \kappa_{ij}^* y_{ij}^*$, where κ_{ij} and κ_{ij}^* are positive parameters. It is thus easy to see that home investment ($K = k^2$) falls and foreign investment rises ($K^* = k^{*2}$) when t falls. Hence, as stated in part (i) of the proposition, trade liberalisation (a fall in t) reduces home output and investment, increases foreign output and investment and reduces the market price.

Given that the intermediate prices are also linear in the corresponding downstream outputs, as stated in part (ii) of the proposition, under outsourcing trade liberalisation raises the foreign and lowers the home intermediate price.

Appendix C – Proof of Proposition 3

As a first step to proving this proposition, we first need to show that the foreign indifference loci fall in t and the corresponding home loci are increasing in t . Define the threshold level of governance costs at which the home (foreign) firm is indifferent between vertical integration and outsourcing given that the other firm chooses $j = O, V$ as \tilde{G}_j (\tilde{G}_j^*). A home indifference locus can be written as $\tilde{G}_j = \lambda_{vj} y_{vj}^2 - y_{oj}^2$, where $0 < \lambda_{vj} < 1$ and a foreign indifference locus can be written as $\tilde{G}_j^* = \lambda_{jv}^* y_{jv}^{*2} - y_{jo}^{*2}$, where $0 < \lambda_{jv}^* < 1$. The parameters $\lambda_{vv} = \lambda_{vv}^* = 5/9$, while $\lambda_{vo} = \left(\frac{5}{9} + \frac{15 - 14\beta^* - \beta^{*2}}{144} \right)$ and $\lambda_{ov}^* = \left(\frac{5}{9} + \frac{15 - 14\beta - \beta^2}{144} \right)$.

As we are concerned with situations in which $G > 0$, the relevant section to consider for these loci is where they are positive.

For the home firm's loci to slope up, i.e. $\frac{d\tilde{G}_j}{dt} > 0$, we need:

$$2 \left[\lambda_{vj} y_{vj} \frac{dy_{vj}}{dt} - y_{oj} \frac{dy_{oj}}{dt} \right] > 0. \quad (A2)$$

Since we are only concerned with $\tilde{G}_j > 0$, we know that $\lambda_{vj} (y_{vj})^2 \geq (y_{oj})^2$ and hence:

$$\sqrt{\lambda_{vj}} y_{vj} \geq y_{oj}. \quad (A3)$$

In all cases, it can also be shown that $\sqrt{\lambda_{vj}} \frac{dy_{vj}}{dt} > \frac{dy_{oj}}{dt}$. When this is combined with (A3), we get (A2) and hence the loci slope up.

For the foreign firm's loci to slope down, i.e. $\frac{d\tilde{G}_j^*}{dt} < 0$, we need:

$$2 \left[\lambda_{jv}^* y_{jv}^* \frac{dy_{jv}^*}{dt} - y_{jo}^* \frac{dy_{jo}^*}{dt} \right] < 0. \quad (A4)$$

It follows from $\lambda_{jv}^* y_{jv}^{*2} \geq y_{jo}^{*2}$ that:

$$\sqrt{\lambda_{jv}^*} y_{jv}^* \geq y_{jo}^* \quad (A5)$$

In each case it can be shown that $\sqrt{\lambda_{jV}^*} \frac{dy_{jV}^*}{dt}$ is more negative than $\frac{dy_{jO}^*}{dt}$. When this is combined with (A5), we get (A4), which implies that the loci are downward sloping.

Proof of Proposition 3(i). The proof follows directly from the slope of the loci. When its rival chooses mode of operation j , then above $\tilde{G}_j(\tilde{G}_j^*)$ the home (foreign) firm chooses to outsource and below the locus it chooses to vertically integrate. \tilde{G}_j^* is monotonically decreasing in t . Thus, at a given G , a fall in t that results in a crossing of this threshold will move us to a point below \tilde{G}_j^* ; hence, if the home firm is choosing mode of operation j , a fall in t will result in a switch to vertical integration by the foreign firm. Similarly, given that \tilde{G}_j is monotonically increasing in t , at a given G , a fall in t that results in a crossing of this threshold will move us to a point above \tilde{G}_j and, if the foreign firm is choosing mode of operation j , result in a switch to outsourcing by the home firm. Hence, a fall in t cannot lead to a switch towards (away from) vertical integration for the home (foreign) firm.

Proof of Proposition 3(ii). When trade liberalisation, or any other change, results in a switch in the mode of operation of one of the firms, it leads to a discrete change in outputs. For instance, since $\tilde{G}_j = \lambda_{vj} y_{vj}^2 - y_{oj}^2 \geq 0$ (where $0 < \lambda_{vj} < 1$), it must be the case that $y_{vj} > y_{oj}$. Similarly, it can be shown that $y_{jV}^* > y_{jO}^*$ at \tilde{G}_j^* . Total industry output moves in the same direction as that of the firm that changes its mode of operation. To see this, consider what happens to total output when the home firm changes its mode of operation. When home chooses mode of operation $i=O,V$, the response of the foreign firm, given in (A1), can be written in more compact notation as

$$y_{ij}^* = \frac{\alpha_j^* - y_{ij}}{b_{ij}^*}, \text{ where } \alpha_j^* = A + \delta^* \rho^* - \Phi \text{ and } \delta^* \text{ is an indicator variable that is unity if the firm}$$

outsources and zero if it is vertically integrated. From (A1), α_j^* does not depend on the home firm's mode of operation but only on that of the foreign firm. Total output when home is vertically integrated and foreign chooses $j=O,V$ then depends on the output of the home firm as follows:

$$Y_{vj} = y_{vj} + y_{vj}^* = \frac{\alpha_j^* + (b_{vj}^* - 1)y_{vj}}{b_{vj}^*} \quad (\text{A6})$$

Similarly total output when home outsources and foreign chooses $j=O,V$ then is

$$Y_{Oj} = y_{Oj} + y_{Oj}^* = \frac{\alpha_j^* + (b_{Oj}^* - 1)y_{Oj}}{b_{Oj}^*} \quad (A7)$$

Thus:

$$b_{Vj}^* Y_{Vj} - b_{Oj}^* Y_{Oj} = (b_{Vj}^* - 1)y_{Vj} - (b_{Oj}^* - 1)y_{Oj} \quad (A8)$$

If the RHS of (A8) is positive then, since $b_{Vj}^* \leq b_{Oj}^*$, we must have $Y_{Vj} > Y_{Oj}$. We must therefore

check that the RHS of (A8) is positive. This will be true if $\frac{y_{Vj}}{y_{Oj}}$ is larger than $\frac{(b_{Oj}^* - 1)}{(b_{Vj}^* - 1)}$. We

know that $\frac{y_{Vj}}{y_{Oj}}$ must be at least as large as $\frac{1}{\sqrt{\lambda_{Vj}}}$. Hence, a sufficient condition for $Y_{Vj} > Y_{Oj}$ is that

$$\frac{1}{\sqrt{\lambda_{Vj}}} \text{ is larger than } \frac{(b_{Oj}^* - 1)}{(b_{Vj}^* - 1)}.$$

First, consider the case in which the foreign firm is vertically integrated. Then,

$$\frac{1}{\sqrt{\lambda_{VV}}} = \sqrt{\frac{9}{5}}, \quad b_{VV}^* = 4/3 \text{ and } b_{VV}^* = (17 - \beta)/12. \text{ Using this, it is easy to check that } \frac{1}{\sqrt{\lambda_{VV}}} \text{ is greater}$$

than $\frac{(b_{OV}^* - 1)}{(b_{VV}^* - 1)}$ and so $Y_{VV} > Y_{OV}$.

Next, consider the case in which the foreign firm is outsourcing. Then, we must make use

$$\text{of } \frac{1}{\sqrt{\lambda_{VO}}} = \frac{1}{\sqrt{\left(\frac{5}{9} + \frac{15 - 14\beta^* - \beta^{*2}}{144}\right)}}, \quad b_{VO}^* = \frac{6 + \beta^* + \beta^{*2}}{2(1 + \beta^*)} \quad \text{and}$$

$$b_{OO}^* = \frac{6 + \beta^* + \beta^{*2} + (1 - \beta)\nu}{2(1 + \beta^*)} \text{ where } \nu = \frac{1 - \beta^{*2}}{15 + \beta + \beta^* - \beta\beta^*}. \text{ It is straightforward to verify that:}$$

$$\frac{1}{\sqrt{\lambda_{VO}}} > \frac{(b_{OO}^* - 1)}{(b_{VO}^* - 1)} \text{ and so that } Y_{VO} > Y_{OO}.$$

Analogous calculations can be used to show that when the foreign firm changes its mode of operation to vertical integration, this results in a discrete increase in its own and in industry output.

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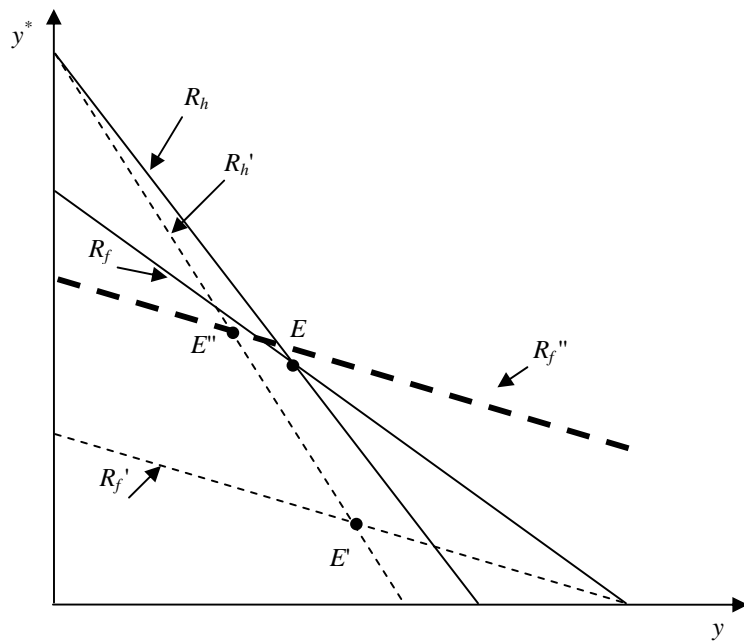


Figure 1. Output response functions ($\Phi=0$)

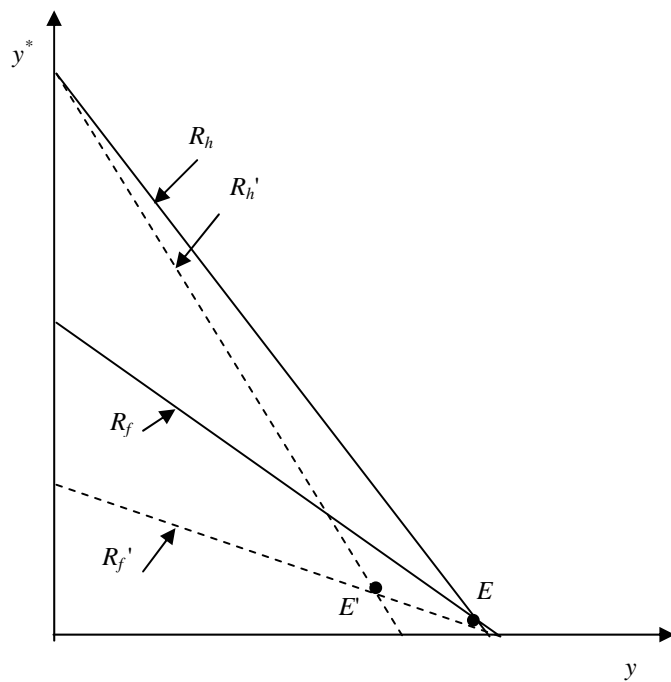


Figure 2. Output response functions (Φ is large and $\rho^*=0$)

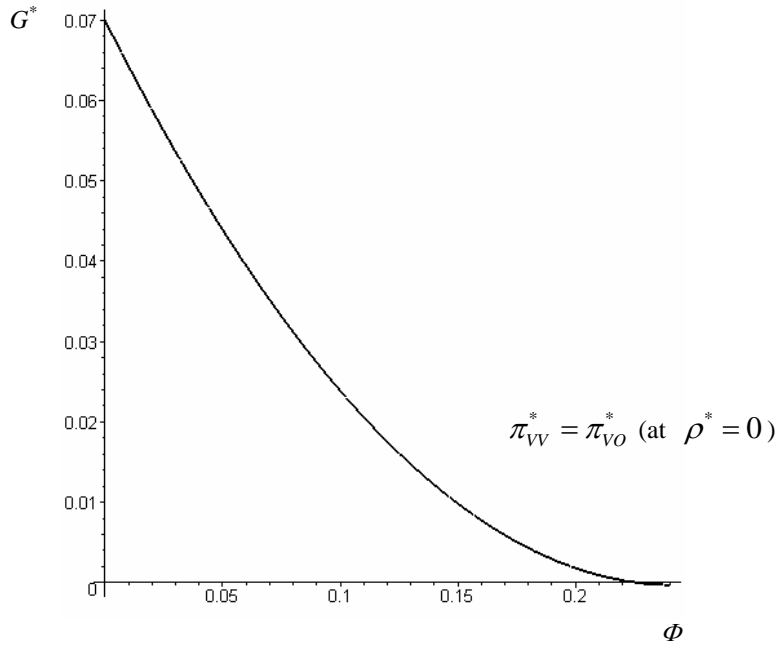


Figure 3. Foreign firm's profit indifference locus when the home firm vertically integrates

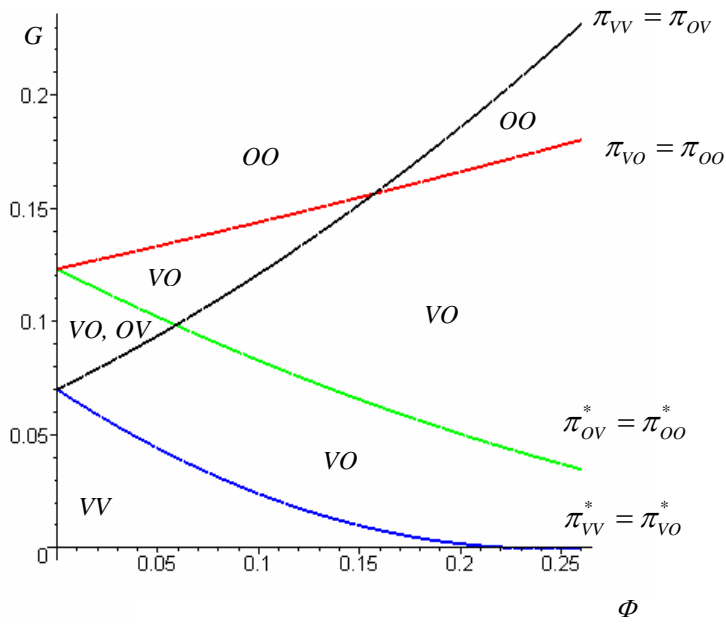


Figure 4. Both firms choose their mode of operation (in the figure $G=G^*$ and $\rho^* = 0$)

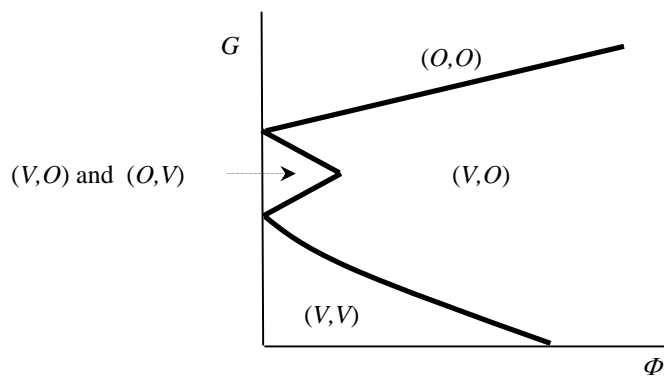


Figure 5. Both firms chose their mode of operation: regime demarcation lines

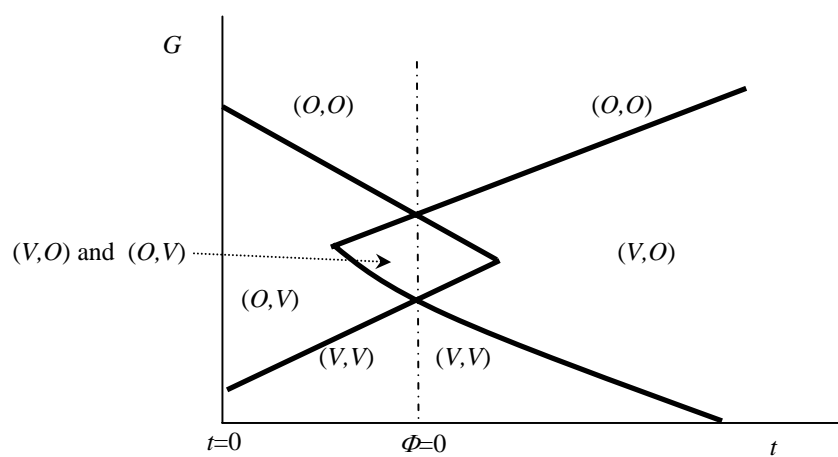


Figure 6. Both firms chose their mode of operation: the effects of trade liberalisation